

CLAIMS

1. A carbonate spring producing system which dissolves a carbonic acid gas in hot water to produce carbonate springs, the carbonate spring producing system characterized by including:

carbonic acid gas supply means;

hot water supply means;

a carbonic acid gas dissolver which is connected to the carbonic acid gas supply means and connected to the hot water supply means;

a liquid lead-out pipe which is connected on a downstream side of the carbonic acid gas dissolver;

a gas-liquid separator which is arranged in a way of the liquid lead-out pipe; and

bubble detection means which detects a bubble amount of the carbonate springs.

2. A carbonate spring producing system according to claim 1, characterized in that the hot water supply means has hot water circulating means for circulating the hot water in a bath.

3. A carbonate spring producing system according to claims 1 or 2, characterized in that the bubble detection means includes:

an ultrasonic transmitter;

an ultrasonic receiver which receives an ultrasonic wave transmitted from the ultrasonic transmitter, the ultrasonic

receiver being arranged across the liquid lead-out pipe from the ultrasonic transmitter; and

a determination unit which computes ultrasonic intensity received with the ultrasonic receiver, the determination unit making the determination by comparing the ultrasonic intensity to a predetermined threshold,

when the ultrasonic intensity is lower than the threshold, the determination unit determines that an anomaly exists in the liquid lead-out pipe, and the determination unit outputs an abnormal signal.

4. A carbonate spring producing system according to claim 3, characterized in that the ultrasonic transmitter and the ultrasonic receiver are horizontally placed.

5. A carbonate spring producing system according to claims 3 or 4, characterized in that the liquid lead-out pipe provided between the ultrasonic transmitter and the ultrasonic receiver is horizontally arranged.

6. A carbonate spring producing system according to claims 1 or 2, characterized in that the bubble detection means includes a liquid level sensor arranged inside the gas-liquid separator, and

when a liquid level in the gas-liquid separator is lower than a predetermined threshold, the bubble detection means determines that the anomaly exists in the liquid lead-out pipe, and the bubble detection means outputs the abnormal signal.

7. A carbonate spring producing system according to any one of claims 3 to 6, characterized in that the carbonic acid gas supply means has an electromagnetic valve, and the electromagnetic valve is controlled to be closed by the abnormal signal from the bubble detection means.

8. A carbonate spring producing system according to any one of claims 1 to 7, characterized in that the carbonic acid gas supply means has a flow rate control valve which performs control to keep a carbonic acid gas flow rate constant.

9. A carbonate spring producing system according to any one of claims 1 to 8, characterized in that the hot water supply means has liquid sending means which performs controls to maintain a constant hot water flow rate supplied to the carbonic acid gas dissolver.

10. A carbonate spring producing system according to any one of claims 1 to 9, characterized in that a throttle which increases water pressure in the gas-liquid separator is arranged in the liquid lead-out pipe.

11. A carbonate spring producing system which dissolves a carbonic acid gas in hot water to produce carbonate springs, the carbonate spring producing system characterized by including:

carbonic acid gas supply means;

a control valve which controls a flow rate of the carbonic acid gas;

hot water supply means;

a carbonic acid gas dissolver which is connected to the carbonic acid gas supply means and connected to the hot water supply means;

a gas-liquid separator which is connected on a downstream side of the carbonic acid gas dissolver;

an un-dissolved carbonic acid gas lead-out pipe which is connected on an upstream side of the carbonic acid gas dissolver while connected to the gas-liquid separator;

a liquid lead-out pipe which is connected to the gas-liquid separator;

a control valve which controls a flow rate of un-dissolved carbonic acid gas from the gas-liquid separator;

a compressor which is arranged in a way of the un-dissolved carbonic acid gas lead-out pipe;

detection means for measuring a liquid level of the gas-liquid separator, and

flow rate control means for controlling the flow rate of the supplied carbonic acid gas and the flow rate of the un-dissolved carbonic acid gas based on the liquid level of the gas-liquid separator.

12. A carbonate spring producing system according to claim 11, characterized in that the flow rate control means performs control to raise the liquid level of the gas-liquid separator higher than the liquid lead-out pipe of the gas-liquid separator.

13. A carbonate spring producing system according to claims 11 or 12, characterized by including:

a gas emission pipe which is connected to the gas-liquid separator; and

an emission control valve which is arranged in a way of the gas emission pipe.

14. A carbonate spring producing system according to claims 11 or 12, characterized by including:

piping which connects a discharge side and an inlet side of the compressor; and

a control valve which is arranged in the way of the piping, the control valve opening and closing the piping.

15. A carbonate spring producing system according to any one of claims 11 to 14, characterized by including gas flow rate control means for measuring a rate at which the liquid level is lowered in the gas-liquid separator with a device, the gas flow rate control means computing a carbonic acid gas concentration of the sending hot water to control the flow rate of the supplied carbonic acid gas.

16. A carbonate spring producing system according to claim 15, characterized by further including:

concentration setting means for setting the desired carbonic acid gas concentration; and

gas flow rate control means for controlling the flow rate of the supplied carbonic acid gas such that the concentration

of the sending hot water becomes equal to a value set by the concentration setting means.